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Postharvest Handling
Technical Bulletin

BITTER MELON

Postharvest Care and Market Preparation

Technical Bulletin No. 19

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POSTHARVEST HANDLING TECHNICAL SERIES

BITTER MELON

Postharvest Care and Market Preparation

Ministry of Fisheries, Crops and Livestock
New Guyana Marketing Corporation
National Agricultural Research Institute

Technical Bulletin No. 19

January 2004

With the assistance of the United States Agency for International Development

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Preface

This publication is part of a series of technical bulletins that seek to provide specific recommendations for improvements in postharvest care and market preparation for selected non-traditional agricultural products. The intended audience for this series is primarily extension agents.

Initial market assessments in current export markets and visits with producers and exporters in Guyana have shown the quality of fresh produce currently exported is uneven and in some instances very poor. Stages all along the export chain from harvest and pre-harvest to transportation and final export are all in need of improvement. Pre-harvest practices, sanitation at the packinghouse, packaging, bacterial and fungal problems, and transportation were all identified as areas where improvement could benefit the quality and increase the shelf life of Guyana's fresh produce exports. The technical bulletins address these issues specific to each product. Harvesting techniques and crop maturity indices are provided. Preparation for market, including cleaning, sorting, packing and transportation are covered. The bulletins address and recommend specific storage conditions, covering temperature and humidity controls. Finally the bulletins address postharvest diseases and insect damage.

The undertaking of these technical bulletins is a joint effort of the Ministry of Fisheries, Crops and Livestock; the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI) to improve quality, increase production and promote exports. As a team, the three agencies are working on the problems, limitations, and constraints identified in the initial reconnaissance surveys, from production and post harvest handling problems, to packaging and transportation, to final market.

Introduction

Bitter melon (*Momordica charantia*) is a vining vegetable of the Cucurbit family that produces heavily warted fruit resembling a small pointed cucumber. The fruits are characterized by a pebbly surface of smooth warts and smooth lengthwise ridges. Skin colour ranges from a very light green to a medium green. Highest quality fruit is produced from vines that are trellised upright rather than left to trail along the soil surface. Keeping the fruit off the ground produces a cleaner more attractive fruit. Essentially all the Guyanese production of bitter melon is marketed domestically. Export opportunities exist in supplying product to certain specialty markets.

Harvest Maturity Indices

The initial fruit are typically ready for harvest about 2 months after planting, depending on cultivar and growing conditions. It typically takes about 10 days from flowering until harvest. The two main external indices of bitter melon harvest maturity are fruit size and skin colour. Bitter melon fruit should be harvested at an immature stage, near full size but before the skin starts to change colour. The main internal indices of harvest maturity are seed colour, flesh colour, texture, and the amount of bitter taste sensation.

The principal external index of harvest maturity is fruit size. The proper size depends on the use and the cultivar. Bitter melons should be at least 10 cm (4 in.) long, but may be of acceptable quality up to 30 cm (12 ins.) in length in some cultivars (Figure 1). Diameter at the center of the fruit should be between 5 cm to 6.4 cm (2 in to 2.5 in). The fruit should be firm to the touch with a tender skin.

Skin colour is another widely used index of assessing fruit maturity. The peel should be a uniform colour when harvested, ranging from light green to dark green depending on cultivar (Figure 2). The fruit surface should also have a noticeable shine.

Figure 1. Bitter melon fruit at appropriate size for harvest.

Figure 2. Fruit of uniformly coloured light or dark green skin from two different cultivars.

The fruit should not be allowed to turn yellow or orange, as this is an obvious indication of over-maturity (Figure 3). Fruit that are too mature have a tough leathery skin and the peel may also split open.

Figure 3. Over-mature fruit with noticeable orange or yellow skin colour.

In the case where over-mature fruit have been inadvertently left on the vine, they should be removed as soon as possible. Over-mature fruit will retard flowering and the development of new fruit. Over-mature fruit are either unmarketable or will have to be sold at a discounted price.

A cross sectional slice obtained from the center of the fruit can be taken to assess internal fruit maturity. At proper harvest maturity, the flesh will have a uniform white colour (Figure 4) along with immature white seeds. The internal flesh of bitter melon turns a brilliant yellow as the fruit ripens and the seeds become tough and darken. Any yellow colouration of the flesh indicates fruit over-maturity. The flesh texture should be firm but not tough. Small hollow cavities often develop in the flesh of over-mature fruit and the texture becomes spongy. The taste of over-mature fruit also becomes noticeably bitter.

Figure 4. Uniform white-coloured flesh of bitter melons at optimal maturity stage.

It is recommended that harvesting be conducted in the cooler parts of the day, preferably in the morning, and the harvested bitter melons be kept as cool as possible. The fruit generally have their highest water content at this time. However, harvest should be delayed until the leaves and fruit have completely dried. Harvesting when the plants are wet will encourage the spread of foliar diseases. Waiting until the afternoon to begin harvest will result in slightly softer and less firm fruit. Bitter melons should be harvested every other day for best yield and quality. The fruit grows rapidly and picking the fruit as soon as they reach marketable size will maintain the vigor and productive capacity of the plant. The fruit should be handled carefully to prevent bruising and injury to the surface.

Harvest Methods

Bitter melons should be carefully removed from the vine using one of two harvest techniques. The first technique involves squeezing the stem attached to the vine between the thumbnail and forefinger, followed by pulling off the fruit from the vine. This will leave a jagged stem section that will require trimming with a sharp knife. The second technique, which is preferable, is to use a small knife to severe the fruit stem from the vine at a point just above the shoulder of the fruit. Done properly, the stem will not have

to be re-cut during packing. Bitter melons should not be torn off the vine, as this will result in damage to the vine and/or fruit.

The harvested fruit should be carefully put in a light-weight field container lined with protective padding or paper to prevent fruit scarring and abrasion. The container should be well-ventilated and filled with no more than about 15 kg (33 lbs) of fruit. Once the field container is full, it should be taken to a shaded, well-ventilated temporary holding area. Avoid leaving the fruit exposed to direct sun. The bitter melons should be moved to the cleaning and packing area as soon as possible.

Preparation for Market

Cleaning

Bitter melons produced from trellised fields will require little, if any, cleaning since the fruit does not come in contact with the soil. However, fruit from non-trellised fields will need cleaning. Soil adhering to the ground spot area or other surface stains should be removed at the time of harvest. This can be done manually by rubbing the fruit surface with a soft damp cloth or cotton gloves. Washing the fruit is more efficient if the bitter melons are particularly dirty, or if the quantity of fruit is large. In this case, the fruit should be submerged in clean water and gently scrubbed with a soft bristled brush. The wash water should be properly sanitized to reduce the potential for spread of disease. Sodium hypochlorite (household bleach) is commonly used since it is an inexpensive and readily available wash water-sanitizing agent. It is effective against decay organisms when added to the wash water at a concentration of 150 ppm and the water is maintained at a pH of 6.5. As the wash water becomes contaminated with dirt and debris, the sanitizing ability of hypochlorous acid is reduced. The water should be changed when necessary and replaced with clean water treated with 150 ppm hypochlorous acid. After cleaning, the fruit is generally placed on a soft mesh or wire table to dry before sorting and grading.

Grading

Bitter melon quality is primarily based on size, uniformity of shape, firmness, and skin colour. Additional quality indices include the amount of surface blemishes and incidence of decay. High quality bitter melon fruit should be fresh in appearance, free from visual defects, uniformly coloured, firm, straight, and glossy (Figure 5). There are no established grade standards for bitter melon. However, the minimum acceptable fruit length in most markets is 4 cm (1.6 in). The preferred diameter at the center of the fruit typically ranges between 5 cm to 6.4 cm (2 in to 2.5 in). Over-mature fruit with yellow or orange

Figure 5. High quality uniformly coloured bitter melons with a glossy skin.

skin colouration should not be marketed. These fruit will generally have an unacceptable bitter flavor.

Packing

Bitter melons should be packed in strong, well-ventilated containers. Wooden containers that allow for stacking without collapsing are appropriate for the domestic market. Durable plastic crates are also acceptable. Mesh sacks should not be used as they provide little or no protection to the fruit.

Bitter melons for export should be packed in clean well-ventilated fiberboard cartons with minimum test strength of 275 psi. Carton size varies depending on market destination, but typically contains 6 kg or 10 kg (13 lb to 22 lb) of fruit. The bitter melons should be oriented in the same direction inside the package (Figure 6).

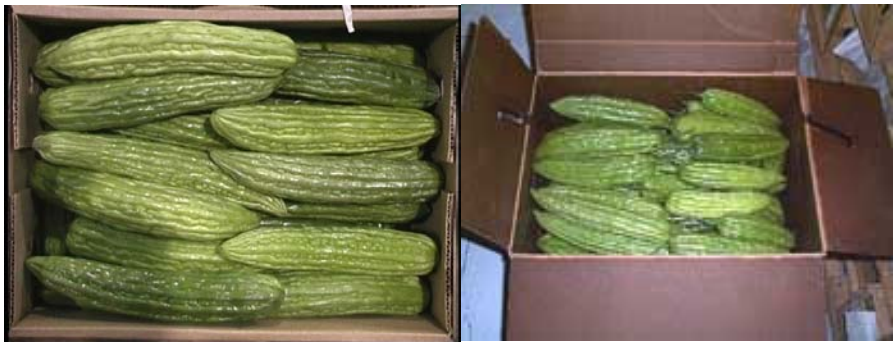

Figure 6. Export quality bitter melons oriented in the same direction inside the cartons.

Temperature Management

The optimum postharvest temperature for bitter melon is 10°C (50°F). At this temperature, bitter melons can be expected to have a 2 to 3 week market life. Holding bitter melons without refrigeration at ambient temperature will result in noticeable shriveling, softening, and decay after 3 to 4 days. Storage of bitter melons below 7°C (45°F) should be avoided, as this will result in chilling injury.

Relative Humidity

Although bitter melons have a waxy skin, they are susceptible to water loss during storage and marketing. Bitter melon fruit will soften and lose their crisp texture within several days at a low relative humidity (RH). In addition, the fruit may discolour and show signs of shriveling. The optimal RH for holding bitter melons is 95%.

Principal Postharvest Diseases

Bitter melons are susceptible to a number of postharvest diseases. The incidence of disease can be reduced by using good pre-harvest disease control practices, careful

harvesting and handling to minimize injury to the delicate tissue, cleaning of the fruit in properly sanitized water, and holding the bitter melons at 10°C (50°F).

Alternaria Rot

Alternaria rot, caused by the fungus *Alternaria alternata*, is a common soil-borne pathogen that causes postharvest fruit rot of bitter melons. Fruit that have been stored for extended periods are more susceptible to Alternaria, along with fruit which have been damaged from chilling injury. Infection typically begins on injured areas of the skin and initial symptoms are tan-coloured circular to oval lesions on the fruit surface. The lesions become sunken and are covered by a dark mould.

Belly Rot

Belly rot, caused by the soil-borne fungus *Rhizoctonia solani*, is a common fruit rot on non-trellised bitter melons, especially during the rainy season. Typical symptoms of belly rot include a dark brown water-soaked decay on the side of the fruit in contact with the soil, followed by a yellowish-brown discolouration of the fruit surface. Belly rot develops rapidly at ambient temperature and the entire fruit can rot within several days.

Cottony Leak

Cottony leak, caused by the soil-borne fungus *Pythium*, is another postharvest disease associated with fruit produced in poorly drained areas or during the rainy season. Infection occurs in the field and decay may progress rapidly after harvest. The first symptoms of cottony leak are soft, dark green, water soaked lesions on the fruit surface. After the fungus penetrates the skin, fluid may be exuded. A white, cottony fungal growth develops on the fruit surface. Decay spreads rapidly at ambient temperatures and during transit, with the formation of nests of mouldy fruit exuding watery juices.

Rhizopus Soft Rot

Rhizopus soft rot, caused by the fungus *Rhizopus stolonifer*, is a common postharvest decay of bitter melon. The fungus becomes established in wounded areas of the fruit, forming yellowish-brown water-soaked spots with a fairly distinct boundary. The spots are irregular in shape and develop into sunken lesions. Grayish-white masses of mould develop over the wounded area, which eventually turn black. Diseased tissue is soft and very wet.

Botryodiplodia Rot

This fungal disease, caused by *Botryodiplodia theobromae*, can cause serious losses of bitter melons grown in warm, humid areas. Fruits are infected via wounds and symptoms include the formation of light brown lesions with a water-soaked margin. The lesions are frequently found at the stem end. A dark gray mould may develop on the surface of the

lesions. The fruit usually undergoes a dry rot and a sour odour usually accompanies the decay.

Bacterial Soft Rot

Bacterial soft rot, caused by *Erwinia carotovora*, is the principle postharvest bacterial disease of bitter melons. It infects the fruit via wounds in the skin and often becomes established in areas infected with fungal disease. Soft rot rapidly disintegrates the flesh, turning it into a soft mass of leaky tissue. The infected fruit typically have a foul odour.

Physiological Disorders

Chilling Injury

Bitter melons are susceptible to chilling injury (CI) if held below 8°C (46°F) for more than several days. The amount of CI depends on temperature and cultivar. Tissue damage becomes more severe with decreasing temperature. Symptoms of CI include tissue collapse, water-soaked spots, darkening of the skin, and increased susceptibility to postharvest decay. Symptoms of CI may occur after 1 week at 4°C (39°F).

ANNEX 1

PUBLICATIONS IN THE POSTHARVEST HANDLING TECHNICAL BULLETIN SERIES

PH Bulletin No. 1	Pineapple: Postharvest Care and Market Preparation, November 2002.
PH Bulletin No. 2	Plantain: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 3	Mango: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 4	Bunch Covers for Improving Plantain and Banana Peel Quality, June 2003.
PH Bulletin No. 5	Papaya: Postharvest Care and Market Preparation, June 2003.
PH Bulletin No. 6	Watermelon: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 7	Peppers: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 8	Oranges: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 9	Tomato: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 10	Okra: Postharvest Care and Market Preparation, October 2003.
PH Bulletin No. 11	Pumpkin: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 12	Lime: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 13	Grapefruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 14	Passion Fruit: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 15	Green Onions: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 16	Sweet Potato: Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 17	Eggplant (Boulanger): Postharvest Care and Market Preparation, January 2004.
PH Bulletin No. 18	Avocado (Pear): Postharvest Care and Market Preparation, January 2004
PH Bulletin No. 19	Bitter Melon: Postharvest Care and Market Preparation, January 2004.

OTHER PLANNED PUBLICATIONS

Bora: Postharvest Care and Market Preparation.

Cassava: Postharvest Care and Market Preparation.

Eddoes: Postharvest Care and Market Preparation.

Ginger: Postharvest Care and Market Preparation.

Breadfruit: Postharvest Care and Market Preparation.

Cabbage: Postharvest Care and Market Preparation.

Calaloo: Postharvest Care and Market Preparation.

Coconut: Postharvest Care and Market Preparation.

Cucumber: Postharvest Care and Market Preparation.

Lemon: Postharvest Care and Market Preparation.

Starfruit: Postharvest Care and Market Preparation.

Tangerine: Postharvest Care and Market Preparation.

Yam: Postharvest Care and Market Preparation.

Harvest Maturity Indices

The first fruit are normally ready for harvest about 2 months after planting, depending on cultivar and growing conditions. It usually takes about 10 days from flowering until harvest.

The main external sign of harvest maturity is the size of the fruit. The fruit should be harvested at an immature stage, before reaching full size. The proper size depends on the use and the cultivar. Bitter melons should be at least 10 cm (4 inches) long, but may be of acceptable quality up to 30 cm (12 in) in length in some cultivars. Diameter at the center of the fruit should be between 5 cm to 6.4 cm (2 in to 2.5 in). The fruit should be firm to the touch with a tender skin.

Skin colour is another widely used guide of judging fruit maturity. The peel should be an even colour when harvested, ranging from light green to dark green, depending on the cultivar. The fruit should be harvested before the skin starts to change yellow or orange in colour. This is an obvious sign of over-maturity. The fruit surface should also have a noticeable shine.

Fruit that are over mature have a tough leathery skin and the peel may also split open. In the case where over-mature fruit have been left on the vine, they should be removed as soon as possible. Over-mature fruit will retard flowering and the development of new fruit.

A cross sectional slice taken from the center of the fruit can be taken to judge fruit ripeness. When the fruit is harvested at the correct time, the flesh will have a uniform white colour along with immature white seeds. Any yellow colouration of the flesh indicates fruit over-maturity. The flesh texture should be firm but not tough. Small hollow holes often develop in the flesh of over-mature fruit and the texture becomes spongy. The taste of over-mature fruit also becomes noticeably bitter.

It is suggested that harvesting be done during the coolest time of the day, best in the morning, and the harvested bitter melons be kept as cool as possible. The fruit generally have their highest water content at this time. However, harvest should be delayed until the leaves and fruit have completely dried to avoid the spread of diseases. Bitter melons should be harvested every other day for best yield and quality.

Harvest Methods

Bitter melons should be carefully removed from the vine using one of two harvest techniques. The first technique involves squeezing the stem attached to the vine between the thumbnail and forefinger, followed by pulling off the fruit from the vine. This will leave a jagged stem which will need to be trimmed with a sharp knife. The second technique, which is better, is to use a small knife to severe the fruit stem from the vine at a point just above the shoulder of the fruit. Done properly, the stem will not have to be re-cut during packing. Bitter melons should not be torn off the vine, as this will result in damage to the vine and/or fruit.

The harvested fruit should be carefully put in a light-weight field container lined with protective padding or paper to prevent fruit scarring and abrasion. The container should be well-ventilated and filled with no more than about 15 kg (33 lb) of fruit. Once the field container is full, it should be taken to a shaded, well-ventilated temporary holding area. Avoid leaving the fruit exposed to direct sun.

Preparation for Market

Cleaning

Bitter melons produced from trellised fields will require little, if any, cleaning since the fruit does not come in contact with the soil. However, fruit from non-trellised fields will need cleaning. Soil on to the ground spot area or other surface stains should be removed by rubbing the fruit surface with a soft damp cloth or cotton gloves. Washing the fruit is more efficient if the bitter melons are particularly dirty, or if the quantity of fruit is large. In this case, the fruit should be submerged in clean water and gently scrubbed with a soft bristled brush. The wash water should be properly sanitized to reduce the potential for spread of disease. The wash water should be sanitized with 150 ppm hypochlorous acid (household bleach) maintained at a pH of 6.5. This is equal to 2 oz of household bleach (such as Marvex) per 5 gallons of water, or .3 liters of bleach per 100 liters of water. After cleaning, the fruit is generally placed on a soft mesh or wire table to dry before sorting and grading.

Grading

Bitter melon quality is mainly based on size, uniformity of shape, firmness, and skin colour. Additional quality indices include the amount of surface blemishes and incidence of decay. High quality bitter melon fruit should be fresh in appearance, free from visual defects, even coloured, firm, straight, and glossy. There are no established grade standards for bitter melon. However, the minimum acceptable fruit length in most markets is 4 cm (1.6 in). The preferred diameter at the center of the fruit typically ranges between 5 cm to 6.4 cm (2 in to 2.5 in). Over-mature fruit with yellow or orange skin colouration should not be marketed. These fruit will generally have an unacceptably bitter flavour.

Packing

Bitter melons should be packed in strong, well-ventilated containers. Wooden containers that allow for stacking without collapsing are suitable for the domestic market. Durable plastic crates are also acceptable. Mesh sacks should not be used as they provide little or no protection to the fruit.

Bitter melons for export should be packed in clean well-ventilated fiberboard cartons with a minimum test strength of 275 psi. Carton size varies depending on market destination, but typically contains 6 kg to 10 kg (13 lb to 22 lb) of fruit. The bitter melons should be oriented in the same direction inside the package.

Temperature Management

The best postharvest temperature for bitter melon is 10° C (50°F). At this temperature, bitter melons can be expected to have a 2 to 3 week market life. Holding bitter melons without refrigeration at ambient temperatures will result in noticeable shriveling, softening, and decay after 3 to 4 days. Storage of bitter melons below 7°C (45°F)

should be avoided, as this will result in chilling injury (CI). The amount of CI depends on temperature and cultivar. Symptoms of CI include tissue collapse, water-soaked spots, darkening of the skin, and increased susceptibility to postharvest decay. Symptoms of CI may occur after 1 week at 4°C (39°F).

Relative Humidity

Although bitter melons have a waxy skin, they are at risk for water loss during storage and marketing. Bitter melon fruit will soften and lose their crisp texture within several days at a low relative humidity (RH). In addition, the fruit may discolour and show signs of shriveling. The best RH for holding bitter melons is 95%.

Principal Postharvest Diseases

The rate of disease can be reduced by using good pre-harvest disease control practices, careful harvesting and handling to minimize injury to the delicate skin tissue, cleaning of the fruit in properly sanitized water, and holding the bitter melons at 10°C.

Alternaria Rot
Alternaria rot begins on injured areas of the skin and initial symptoms are tan-coloured circular to oval spots on the fruit surface. The spots become sunken and are covered by a dark mould. Fruit which have been stored for long periods are more vulnerable to Alternaria, along with fruit which have been damaged from chilling injury.

Belly Rot
Symptoms of belly rot include a dark brown water-soaked decay on the side of the fruit in contact with the soil, followed by a yellowish-brown discolouration of the fruit surface. Belly rot is usually more severe on fruit harvested during the rainy season.

Cottony Leak
Cottony leak is another postharvest disease associated with fruit produced in poorly drained areas or during the rainy season. The first symptoms of cottony leak are soft, dark green, water soaked lesions on the fruit surface. After the fungus penetrates the skin, fluid may be exuded. A white, cottony fungal growth develops on the fruit surface. Decay spreads rapidly at ambient temperatures and during transit, with nests of mouldy fruit giving off watery juices.

Rhizopus Soft Rot
Rhizopus soft rot becomes established in wounded areas of the fruit, forming yellowish-brown water-soaked spots with a fairly distinct edge. The spots are irregular in shape and develop into sunken wounds. Grayish-white masses of mould develop over the wounded area, which eventually turn black. Diseased tissue is soft and very wet.

Botryodiplodia Rot
Symptoms of Botryodiplodia rot include light brown spots with a water-soaked margin. The spots are frequently found at the stem end. A dark gray mould may develop on the surface of the spots. The fruit typically undergoes a dry rot and a sour odour usually accompanies the decay.

Bacterial Soft Rot
Bacterial soft rot infects the fruit via wounds in the skin and often becomes established in areas infected with fungal disease. Soft rot rapidly crumbles the flesh, turning it into a soft mass of leaky tissue. The infected fruit typically have a foul odour.

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With the assistance of
The United States Agency for International Development

New Guyana Marketing Corporation

BITTER MELON

Postharvest Care and Market Preparation
Information Sheet

This information sheet provides growers and agriculture extension personnel with a summary of the recommended harvest and postharvest handling practices for bitter melon. A more technical and detailed bulletin is available from the New Guyana Marketing Corporation (NGMC) and the National Agricultural Research Institute (NARI).